# List composition effect on cognate and non-cognate word acquisition in children

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Previous studies on second language (L2) vocabulary acquisition with children showed that the use of a picture learning method favours the creation of direct links between the semantic system and new lexical representations at early stages of L2 acquisition (Comesaña et al., 2009). However, recent studies found that this influence seems to vary according to the cognate status of the words being learned (Comesaña et al., 2012), raising the question of how the type of words involved can modulate the lexical-semantic connections between the words of both languages in the bilingual memory. The main goal of the present study was to explore list composition effects in the establishment of L2 word-to-concept connections in Portuguese children by using a picture-based method. Results showed no influence of list composition in the establishment of L2 lexical-semantic connections when cognates have to be learned. Findings are discussed in light of relevant models of bilingual memory.

**Keywords:** second language acquisition, semantic interference effect, stimuli list composition, cognate status

## 1. Introduction

A significant area of interest in the field of bilingualism and second language acquisition (SLA) concerns the study of how words of first (L1) and second (L2) languages are represented in bilingual memory, as well as how they are accessed

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and selected (e.g., Comesaña, Perea, Pineiro, & Fraga, 2009; Comesaña, Soares, Sanchez-Casas, & Lima, 2012a; Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010; Jiang, 2000; Jiang & Forster, 2001; Van Hell & Kroll, 2012). Based on the Revised Hierarchical Model (RHM) by Kroll and Stewart of 1994 (see Kroll, van Hell, Tokowicz, & Green, 2010; Van Hell & Kroll, 2012, for more recent reviews), several studies have explored the lexical-semantic connections between words in both languages at different stages of L2 acquisition (e.g., Altarriba & Mathis, 1997; Guo, Misra, Tam, & Kroll, 2012; Kroll & Stewart, 1994; Sunderman & Kroll, 2006; Tokowicz, Kroll, de Groot, & van Hell, 2002). According to the RHM, bilingual memory is conceptualized as having a common semantic system for both languages yet two separate lexical memories (see Figure 1).

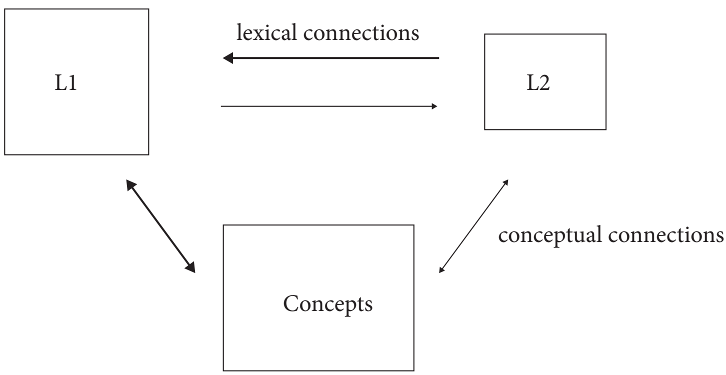


**Figure 1.** The Revised Hierarchical Model (adapted from Talamas, Kroll, & Dufour, 1999), with L1 corresponding to first language and L2 referring to second language

The strength of lexical and semantic connections depicted in Figure 1 (excitatory connections) changes as L2 proficiency increases. Thus, connections in the L2-L1 direction are assumed to be stronger compared with the L1-L2 direction in L2 beginners, because L2 words are usually learned through associations with L1 lexical translation, and also because L1 vocabulary is larger than L2 vocabulary (Jiang, 2000). In addition, because L2 words are mainly learned as formal entities and L1 words are learned as semantic and formal entities (Jiang, 2000), access to the semantic system is assumed to vary in the two languages. Hence, whereas access to the semantic system from L1 is expected to be direct, access from L2 is expected to be lexically mediated through L1. The asymmetries in the strength of lexical-semantic connections are observed in tasks such as translation (when a participant is asked to give a translation of a given word in the other language) in which processing is expected to be faster and less influenced by semantic information in the direction L2-L1 than in the case of L1-L2. However, as L2 proficiency increases, direct links between L2 and the semantic system become stronger, allowing for a similar access to the semantic system from either L1 or L2. For L2 beginners, then, the RHM predicts forward translation (L1-L2) to be based on semantic mediation, whereas backward translation (L2-L1) is assumed to be largely mediated through the lexicon. It is worth noting here an interesting developmental model of bilingual word recognition which incorporates the developmental assumptions of the RHM in terms of changes in lexical-semantic connections (the BIA-d model, Grainger, Midgley, & Holcomb, 2010). This model tentatively explains the underlying mechanisms of the changes that occur in the connectivity between L2 and L1 lexical representations and the conceptual system as L2 proficiency increases. According to the BIA-d model, direct links between L2 and the conceptual system are strengthened (and those between lexical representations from both languages are weakened) due to the improvement of top-down and lateral inhibitory mechanisms that reduce cross-language competition. Interestingly, as L2 proficiency increases, L2 lexical representations are said to be integrated into a single lateral inhibitory network for words from both languages (whereas in the RHM the existence of two different lexical systems is maintained, regardless of L2 proficiency). The RHM and BIA-d models will be compared in detail later.

Studies using different methodologies which are assumed to tap into conceptual processing, such as translation (e.g., de Groot, Dannenburg, & Vanhell, 1994; Sánchez-Casas, García-Albea, & Davis, 1992), translation recognition (e.g., Talamas et al., 1999), and masked semantic priming lexical decision tasks (e.g., Perea, Duñabeitia, & Carreiras, 2008), support the assumptions of the RHM. For instance, Talamas et al. (1999) asked high and low proficiency English (L1)-Spanish (L2) adult bilinguals to perform a translation recognition task, in order to analyse whether access to the semantic system from L2 involved the lexical mediation of L1. In this task, participants were presented with a word in L2 and were asked to decide whether the following L1 word was a correct translation of this. The critical conditions were those in which the second word was an incorrect translation of the L2 word presented (i.e., the "no" responses). In such cases, the incorrect translation could be a word related in form (e.g., *man-hambre* [hunger] instead of *man-hombre* [man]), a word related in meaning (e.g., *man-mujer* [woman]), or an unrelated word with a relation in neither form nor meaning (e.g., *man-ventana* [window]). The analysis of the "no" responses in the different conditions allowed the authors to explore the type of connections established between lexical and semantic systems in the bilingual memory. They hypothesized that proficient bilinguals would take more time and would commit more errors answering "no" to semantically related pairs than to the unrelated pairs, that is, they would show a semantic interference effect (SIE). Conversely, less proficient bilinguals would show a greater interference effect for words related in form due to the existence of stronger lexical connections. In line with the RHM predictions, Talamas et al.

(1999) found that form interference was greater for less proficient bilinguals, while the SIE was greater for more proficient bilinguals. Hence, proficient bilinguals seemed to be less affected by word form, since they relied more on word meaning to perform the task. These results have been confirmed in other studies with low and high proficiency Spanish-Catalan bilinguals (see for instance Ferré, Sánchez-Casas, & Guasch, 2006).

Despite evidence supporting the tenets of the RHM, recent studies have challenged its predictions, since, on one hand, proficient bilinguals also seem to show lexical mediation when processing L2 words (Guo et al., 2012), and, on the other hand, at early stages of L2 acquisition, learners exhibit direct access to the semantic system from L2 words (see Altarriba & Mathis, 1997; de Groot & Poot, 1997; Sunderman & Kroll, 2006 with adults, also Comesaña et al., 2009, 2012a with children). The inconsistency of these results may be due to the influence of variables in L2 processing other than level of proficiency, such as the method used to learn the new words (e.g., Comesaña et al., 2009; Finkbeiner & Nicol, 2003), the type of word being learned (e.g., Comesaña et al., 2012a; Davis et al., 2010; Tokowicz et al., 2002; van Heuven, Dijkstra, & Grainger, 1998), the translation direction (e.g., Davis et al., 2010; Heij, Hooglander, Kerling, & van der Velden, 1996), or even age (Chen & Leung, 1989; Lotto & de Groot, 1998). The present study falls within this area of research, and aims to explore further the extent to which the list composition of words to be learned (using a list in which L2 cognate and non-cognate words were learned separately [blocked condition] and also a list in which the same cognate and non-cognate words were learned jointly [mixed condition]) affects the establishment of L2 word-to-concept connections using a picture-based method.

For the purposes of the present study, a notable prior study is that of Chen and Leung in 1989 in which beginner L2 children and adults had to carry out translation and picture naming tasks in their L2. Results showed that adults were faster at translating, while children named pictures faster. Based on these results, the authors suggested that children rely more on conceptual cues to perform such tasks, whereas adults rely more on lexical cues. If different patterns of results arise in different tasks, it seems likely that the L2 learning method used in children and adults might also have implications for the modulation of lexical-semantic connections during early stages of SLA. This was indeed what Comesaña et al. (2009) demonstrated. The authors assessed the influence of L2 learning method on the establishment and stability of L2 word-to-concept connections in children aged 10–11. Specifically, they explored whether the links from L2 words to the semantic system were mediated by L1 lexical representations or involved direct access, as previous studies with adults had shown (e.g., Altarriba & Mathis, 1997; Ferré et al., 2006; Finkbeiner & Nicol, 2003). For this purpose two different learning methods were used: the L2-L1 word association method *vs.* the L2 word-picture association method. While the former involves the association between an L2 word and its L1 translation equivalent (reinforcing lexical connections), the latter refers to the association between an L2 word and its corresponding picture (reinforcing conceptual connections). Comesaña et al. (2009) also explored how L2 proficiency (beginning vs. proficient children) could modulate the results in a backward-translation recognition task, similar to the one used by Talamas et al. (1999). That is, participants were presented with an L2 word followed by an L1 word, and had to decide whether the L1 word was the correct translation of the L2 word. In this case, the L1 word could be either a correct translation, a semantically related word, or an unrelated word. Both groups of children performed the task at two different moments in time: immediately after the learning phase and a week later, in order to assess the stability of results over time. The authors hypothesized that if the learning method influenced the establishment and stability of links between L2 words and the semantic system, L2 beginners who learned words via the L2 word-picture method would show longer reaction times and make more errors answering "no" to semantically related pairs than those who learned L2 words via the L2-L1 word association method. Results confirmed these predictions, in that proficient and L2 beginners who had learned L2 words through the picture-word method showed a SIE immediately after learning and also a week later, thus extending to children the findings of Altarriba and Mathis' (1997) with adults. On the other hand, L2 beginners from the L2-L1 learning method failed to show a significant SIE. The authors concluded that L2-beginner-children were able to access meaning directly from L2 words, at least when words were learned via pictures.

Nevertheless we might note that in the above study, as in the majority of SLA studies conducted with adults, non-cognate words were used (i.e., translation equivalents that are not similar in form such as *árvore*-tree in European Portuguese (EP)-English respectively). It is important, then, to ascertain whether these effects can also be generalized to other types of words, particularly cognates. Cognate words are translations that share elements of form as well as meaning (e.g., *papel*-paper in EP-English, respectively), and are assumed to benefit from stronger cross-language activation (see Comesaña et al., 2012b; Dijkstra et al., 2010; Timmer, Ganushchack, Ceusters, & Schiller, 2014). Indeed, there is a huge body of evidence showing differential processing of cognate and non-cognate words in bilinguals. More specifically, cognate words are learned faster than non-cognate words both in adults (e.g., de Groot & Keijzer, 2000; Lotto & de Groot, 1998) and in children (Comesaña et al., 2012a), and evoke faster response times and fewer errors in comparison to non-cognates, the so-called cognate facilitation effect (but see Brenders, van Hell, & Dijkstra, 2011, and Comesaña et al., 2015, for inhibitory effects of cognates as a function of L2 proficiency and stimuli list composition). These findings support a non-selective account of lexical access in bilinguals, as assumed by the Bilingual Interactive Activation model (BIA, Dijkstra & van Heuven, 1998), and its extension (the BIA+ model, see Dijkstra et al., 2010; Dijkstra & van Heuven, 2002). According to these models, both languages are activated even when only one language is required for the task. As cognates share orthographic and phonological features as well as meaning, the two lexical representations would be activated during word recognition instead of one (as occurs for non-cognate words), leading to a higher semantic co-activation. This would explain the differential processing observed for cognates relative to non-cognates. At this point, it is important to bear in mind that the RHM, contrary to the BIA models, claims the existence of selective language access and separate lexicons for each language. Thus, a priori, its tenets are incompatible with the cognate effect observed in literature, unless it assumes that the lexical connections for cognate words are stronger than lexical connections for non-cognate ones due to cross-linguistic similarities (see Kroll, Michael, & Sankaranarayan, 1998; Kroll, Michael, Tokowicz, & Dufour, 2002; Sunderman & Schwartz, 2008 for recent reviews of the model in which this argumentation was incorporated; also the BIA-d model proposed by Grainger et al. in 2010 to explain the development of the RHM into a BIA model).

Following this line of reasoning, in a subsequent study Comesaña et al. (2012a) explored the efficacy of the L2 word-picture method over the L2-L1 word association method in the establishment of L2 word-to-concept connections when non-cognate and cognate words were learned simultaneously. In this study, which followed the same procedure used in Comesaña et al. (2009), results showed a faster and more accurate processing for cognate words in both methods, this being consistent with the literature. However, the authors failed to replicate the advantage for the picture-based method previously observed for non-cognate words. Thus, for both learning methods, children showed a SIE in the error data. Nevertheless, the effect was greater for cognate words than non-cognate words, and more importantly, in latency data only those participants from the L2-L1 word association method showed the SIE in both cognate and non-cognate words (in participants from the L2-picture method, the SIE was restricted to cognate words). This led the authors to hypothesize that learning cognates and non-cognates together could have meant that participants learned words based on their orthographic and phonological similarities rather than on their semantic connections. If so, the lexical links between both languages would be reinforced instead of the semantic ones, attenuating the effects previously observed for the L2 word-picture method. That is, when mixing cognate and non-cognate words in the same word list, access to the semantic system might be more strongly lexically mediated. Thus, the authors suggested that the advantage of the L2 word-picture method could only be observed for non-cognate words when they are learned alone (without cognate words), which opens the possibility that list composition could influence the establishment of L2 word-to-concept mappings. This, indeed, is the aim of the present research. It might be noted here that the above hypothesis is consistent with results from a recent study showing that stimuli list composition affects L2 processing in children (Brenders et al., 2011). In Brenders et al.'s study, Dutch children with beginning (sixth grade) and intermediate (seventh and ninth grades) levels of L2 proficiency in English were asked to perform a lexical decision task, considering non-cognate words, cognate words, and false friends (words that share orthographic and phonological characteristics, but with different meanings; e.g., angel [English] – *angel* [Dutch], meaning "stinger" in Dutch). These three types of words were presented in one list, whereas in the other list only cognate and non-cognate words were presented. Results revealed that cognate words were processed faster and more accurately than non-cognate words but, importantly, only when false friends were excluded from the list. When cognate, non-cognate and false friends were presented altogether, an inhibition effect in the processing of cognate words relative to non-cognate words arose (slower reaction times and more errors for cognate words). Thus, the presence of cognate and false friends in the same experimental list led to different results. Interestingly, this inhibition effect for cognate words was not observed in similar studies conducted with adults (Dijkstra, Grainger, & van Heuven, 1999; Dijkstra, van Jaarsveld, & Brinke, 1998). Brenders et al. (2011) explain these discrepancies by assuming that children and adults probably had different levels of L2 proficiency, as the greater the L2 proficiency the lower the cross-language competition. Specifically, as L2 proficiency increases, cognate representations are more strongly activated at both form and meaning levels and thus the influence of the L1 on L2 processing is reduced. However, Brenders et al. did not directly compare the performance of children and adult bilinguals. Moreover, since children in their study pertained to different age groups and had different levels of L2 proficiency, it is unclear whether the modulations observed in L2 word processing were due to L2 proficiency, to age differences, or to the influence of both variables (see Marinova-Todd, Marshall and Snow [2000] for an overview of the relation between age and L2 proficiency in L2 learning). Thus, it is critical to ascertain the effect of list composition on L2 word processing by controlling for L2 proficiency and age, as we will seek to do here.

In this paper, then, we explored the effect that stimuli list composition has at the early stages of L2 new vocabulary acquisition in children, and crucially, if stimuli list composition influences the establishment and stability of L2 cognate and non-cognate word-to-concept connections. The study of list composition in L2 acquisition and processing is important not only for theoretical reasons (to better understand the cognitive mechanisms underlying L2 word representation and processing), but also for applied educational purposes (to help in determining the best way to learn words in a new language). Indeed, as children are still developing their L1, the impact of L1 on L2 word processing might be different from that in adults (see Birdsong, 2006; Klein, 1995; Marinova-Todd et al., 2000; Pienemann, Di Biase, Kawaguchi, & Hakansson, 2005, for overviews of age-related differences in L2 learning).

In sum, the aim of the present research was to examine for the first time the effect of stimuli list composition on the establishment and stability of lexical-semantic connections during the early stages of new vocabulary acquisition. To this end, native-speaking Portuguese children were taught Basque cognate and non-cognate words separately or in a mixed way (blocked vs. mixed condition) by using an L2 word-picture method (a method that seems to reinforce direct links from L2 words to the semantic system, at least when non-cognate words are considered, see Comesaña et al., 2009). They were then asked to perform a backward translation recognition task, both immediately and also a week after learning, to assess the stability of lexical-semantic connections over time. If the establishment of these connections are modulated by the stimuli list composition, as Comesaña et al. (2012a) suggested, then we expected children to make more mistakes and/or to take more time to answer "no" to a semantically related word compared to an unrelated word (a SIE) when words were learned separately than when they were learned in a mixed way. This would reveal direct semantic access from L2 words for children in the blocked condition. (Note that, according to Comesaña et al., learning cognates and non-cognates together might lead to participants learning and processing words by relying more on their orthographic and phonological similarities, which would reinforce the use of lexical links between languages instead of the semantic ones regardless of the method used to learn the words). Additionally, the SIE was expected to be greater in cognate than in non-cognate words due to the influence of cross-language similarities in semantic activation. Finally, and regardless of list composition, faster and more accurate responses for cognate over non-cognate words were expected.

## 2. Method

### 2.1 Participants

Forty-eight fifth grade Portuguese children from a public school in Porto, Portugal (21 males, $M_{age} = 10.29$, $SD = 0.46$) participated in the experiment after their parents had signed a consent form. All were native speakers of EP with some knowledge of the English language (English is part of the compulsory school curriculum).

Importantly, they had no previous knowledge of the Basque language (L2). No participants had either learning/intellectual disabilities or had failed any school year.

## 2.2 Stimuli

Forty-eight high-frequency Basque words were selected from the EuskalHitzak database (Perea et al., 2006). Each Basque word was paired with three EP words: (i) a correct translation (e.g., *zuhaitz* [tree] – *árvore* [tree]), (ii) a semantically related word (e.g., *zuhaitz* [tree] – *folhas* [leaves]), and (iii) an unrelated word (e.g., *zuhaitz* [tree] – *faixas* [sashes]; see Appendix A). Semantically related words were selected from the EP word association database for children (Comesaña, Fraga, Moreira, Frade, & Soares, 2014) whereas unrelated words were taken from the Procura-PALavras lexical database (P-PAL; Soares et al., 2014). Related and unrelated words were matched in length (5.8 and 5.9, respectively, $p = .67$), frequency per million (67.7 and 65.2, respectively, $p = .87$), number of orthographic neighbours (4.3 and 4.6, respectively, $p = .72$) and phonological neighbours (5.1 and 4.5, respectively, $p = .54$), as well as in grammatical category (note that most of the selected words were nouns [85%]). These values were taken from the P-PAL database (Soares et al., 2014). Related and unrelated words were also controlled for their orthographic overlap with Basque words (.12 and .10, respectively, $p = .37$). Three lists of materials were constructed by counterbalancing the items across conditions, so that a given word was associated with the three experimental conditions, though in different lists (e.g., the L2 word "zuhaitz" was paired with its translation in list 1 – *árvore* [tree], with a related word in list 2 – *folhas* [leaves] and with an unrelated word in list 3 – *faixas* [sashes]). In each list, half of the word pairs were cognates (e.g., *eskola-escola* [school], respectively) and the other half were non-cognates (e.g., *esku-mão* [hand], respectively). The degree of orthographic overlap for cognates and non-cognates was computed with the Levensthein Normalized distance algorithm, using the NIM software (Guasch, Boada, Ferré, & Sánchez-Casas, 2013). As expected, cognate words showed a higher degree of orthographic overlap than non-cognate words (.60 and .12, respectively, $p < .001$). Cognates and non-cognates were distributed across conditions in each list (thus in each list cognates were associated with eight translations, eight semantically related words, and eight unrelated words, and the same for non-cognates). Six word pairs were added for practice purposes (two translations, two semantically related words, and two unrelated words). Additionally, 48 black and white pictures (with the size of 8x8cm) were selected from the Snodgrass and Vanderwart database (1980) (31%) or from Googleimages (69%) when no appropriate images were available in the former.

### 2.3 Procedure

The procedure, similar to that used by Comesaña et al. (2012a), involved two phases (learning and test phase; see Figure 2).

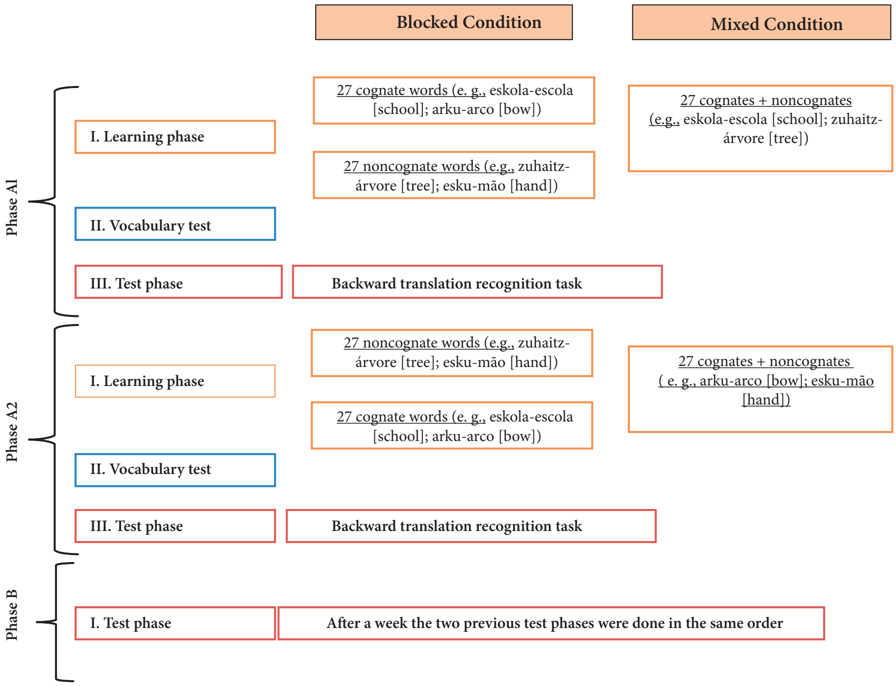


**Figure 2.** Scheme of the employed procedure

Both phases took place individually in a quiet room at the school. During the learning phase, half of the participants learned cognate and non-cognate words in a separate way (blocked condition) while the other half learned both cognate and non-cognate words in a mixed way (mixed condition) by using in both cases a L2-word picture learning method. After explaining the task, participants were first presented with half the stimuli (24 experimental words plus 3 practice items) and then with the other half (24+3), regardless of the experimental condition. Thus, in the blocked condition, participants learned cognate words first and then non-cognate words (or vice-versa), whereas in the mixed condition participants learned cognate and non-cognate words mixed together in each group of words. Regardless of the learning condition (blocked vs. mixed), participants were initially familiarized with the set of pictures in order to guarantee that they were unambiguously categorized with their correct semantic representation. Thus, all pictures were presented in single slides for 2 seconds, along with their corresponding L1 word. Then, in the learning phase of the first half of L2 words, participants were presented with three sets of nine words at a time that could only be cognates or non-cognates (blocked condition) or a mixture of cognates and non-cognates (mixed condition). Each set was presented three times. During the presentations, the experimenter read the Basque words aloud and gave the children time (approximately 7 minutes) to learn the words. After learning each set of 27 words, participants answered a verbal vocabulary test, in which they were asked to say out loud the translations of the Basque words presented. After this, there was a pause of 2 minutes followed by the test phase in which participants were asked to perform a backward translation recognition task. Stimuli presentation and recording of response times and errors for the backward translation recognition task were controlled for using SuperLab 4.5 software. In this task participants were asked to decide as quickly and accurately as possible whether the second L1 word was the correct translation of the first presented L2 word, through the use of two different keys, as depicted in the end of phase A1 in Figure 2. There were 27 trials, the first three of these being for practice. In each trial, a fixation point was presented, at the centre of the screen, for 1000 ms. After that, the Basque word was displayed on the screen for 250 ms, followed by the EP word, which remained on the screen until a response was given by the participant or until 2500 ms had elapsed. Word presentation was randomized across participants.

After completing the first half of the experiment, and after a pause of 4 minutes, participants had to learn the other 27 words and to perform another verbal vocabulary test, as well as another backward translation recognition task (see phase A2 in Figure 2). The whole procedure (learning and testing phases) lasted around 55 minutes. Only participants with a score of 85% or above of correct answers (including both experimental and practice trials) on the two vocabulary tests were considered in the analysis; three participants were excluded on these grounds, and their data were replaced with those of others who shared the same characteristics (note that the demographic characteristics, presented in the participants section, refer to all those who participated in the experiment). Hence, participants performed four tests (two verbal vocabulary tests and two backward translation recognition tasks) immediately after the learning phase (immediate test condition). A week later they were asked to do the two backward recognition tasks in the same order as they had previously done (delayed test condition; see phase B in Figure 2) in order to test the stability of any effects observed in the immediate condition.

## 3. Results

Reaction times (in ms) and error rates from the translation recognition tasks performed immediately and one week after the learning session were considered in the analyses. Incorrect answers, as well as responses faster than 250 ms and slower than 2000 ms, were excluded for latency analyses. It is worth noting that the correct translation condition (i.e., "yes" responses) was excluded from the analysis, as the critical question here was to analyse the difference between semantically related and unrelated words (i.e., "no" responses), as captured by the SIE (see the same approach in Altarriba & Mathis, 1997; Comesaña et al., 2009; Comesaña et al., 2012a). Nevertheless, in order to achieve an enriched picture of participant performance in these tasks, a second analysis was carried out looking at the translation condition. The rationale here was to show that participants' performances were significantly better on correct translation than on incorrect ones (related and unrelated pairs) as an index of word learning. The results of this analysis are presented following the first analysis of the critical conditions. Table 1 presents the mean and standard deviations of reaction times (RT) and percentage of errors (%E) for the translation, semantically related, and unrelated conditions by list composition (blocked vs. mixed), and the cognate status (cognate vs. non-cognates) of the learned words, both in the immediate and delayed tests. The SIE is also presented.

The whole data set as well as the step-by-step protocol followed during the data analysis procedure can be found at the following link: https://www.psi.uminho.pt/pt/investigacao/Psicolinguistica/Documents/script.zip

We analysed RTs and error rates for word targets with linear mixed effects (lme) models. The lme on RTs were conducted with participants and items as crossed random factors, and with random intercept and all repeated measure factors with random slope per subject and not per item (see Barr, Levy, Scheepers, & Tily, 2013; for further discussion see Matuschek, Kliegl, Vasishth, Baayen, & Bats, 2017). For error rates, we used a generalised lme with logistic link function and binomial variance. The models were fit using the lme4 R library (Bates, Maechler, & Bolker, 2011) and LmerTest R library in order to contrast simple effects with differences of least squares means. There was no averaging of the data prior to the analyses.

We first investigated the presence of a significant $2 \times 2 \times 2 \times 2$ interaction between the design factors Cognate status (cognate|non-cognate), Relatedness (related|unrelated), Test moment (immediate|delayed) and List composition (blocked|mixed). The main effects of Relatedness $F(1, 42.55) = 20.16$, $p < .001$, and Test moment $F(1, 47.30) = 35.14$ $p < .001$, were found. The factor Relatedness revealed a SIE, as responses to unrelated words were faster than to related words.

**Table 1.** Mean reaction times (RT) in milliseconds and proportion of errors (E) with standard deviations, in parentheses, by list composition (blocked vs. mixed condition) and cognate status, considering test moment (immediate vs. delayed), through all three experimental conditions (translation, related, unrelated). Semantic interference effects (SIE) are also presented

| | | | Immediate test condition | | | | Delayed test condition | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **List composition** | **Cognate status** | **Dependent variable** | **Translation** | **Related** | **Unrelated** | **SIE** | **Translation** | **Related** | **Unrelated** | **SIE** |
| Blocked condition | Cognate | RT | 976 (275) | 1,217 (305) | 1,133 (283) | −84 | 951 (286) | 1,089 (296) | 1,027 (296) | −62 |
| | | E | 0.06 (0.23) | 0.20 (0.40) | 0.05 (0.22) | −0.15 | 0.08 (0.27) | 0.22 (0.41) | 0.08 (0.28) | −0.14 |
| | Non-cognate | RT | 1,174 (280) | 1,282 (322) | 1,214 (315) | −68 | 1,115 (308) | 1,077 (328) | 1,092 (327) | 15 |
| | | E | 0.13 (0.33) | 0.22 (0.42) | 0.06 (0.24) | −0.16 | 0.23 (0.42) | 0.27 (0.44) | 0.08 (0.34) | −0.19 |
| Mixed condition | Cognate | RT | 910 (329) | 1,196 (344) | 1,086 (308) | −110 | 817 (265) | 1,067 (367) | 977 (283) | −90 |
| | | E | 0.11 (0.31) | 0.30 (0.46) | 0.10 (0.3) | −0.2 | 0.06 (0.24) | 0.36 (0.48) | 0.12 (0.33) | −0.24 |
| | Non-cognate | RT | 1,090 (361) | 1,132 (353) | 1,131 (334) | −1 | 979 (308) | 1,017 (344) | 995 (317) | −22 |
| | | E | 0.20 (0.40) | 0.23 (0.42) | 0.08 (0.27) | −0.15 | 0.36 (0.47) | 0.36 (0.48) | 0.16 (0.37) | −0.2 |

The factor Test moment showed that responses were faster in the delayed than in the immediate test condition. The two-fold interaction between Cognate status x Relatedness also reached significance, $F(1, 2197.04) = 6.09$, $p = .01$ (degrees of freedom with Satterthwaite approximation). We investigated the interaction by simple effects estimation with differences of least squares means. This interaction showed a greater SIE for cognate words than for non-cognate words ($p < .001$ and $p = .08$, respectively). Besides, a cognate facilitation effect was observed for unrelated words, that is, cognates paired with unrelated words were recognized faster than non-cognates paired with unrelated words, $p = .015$. For the cognate and non-cognate words paired with related words the differences did not reach statistical significance.

For the error rates, the results revealed a main effect of Relatedness $\chi^2$ (1) = 154.55, $p < .001$, as participants made more errors for related than for unrelated words (0.27 and 0.10, respectively). The main effect of Test moment was also significant $\chi^2$ (1) = 20.67, $p < .001$, since participants were more precise in the first than in the second test (0.15 and 0.20, respectively). Also, the effect of List composition $\chi^2$ (1) = 4.31, $p = .03$ reached significance. This effect showed that participants from the blocked list made fewer errors than participants from the Mixed list (0.14 and 0.20, respectively). In addition, the two-fold interaction between Cognate status and Test moment was significant, as participants made fewer errors with non-cognate words in the immediate test than in the delayed test (0.15 and 0.25, respectively, $p < .001$). No differences were observed, however, for cognate words. Interestingly, the interaction between Cognate status and List composition approached significance $\chi^2$ (1) = 3.82, $p = .050$. This interaction revealed that participants from the Blocked list made fewer errors with cognate words than participants from the Mixed list (0.11 and 0.18, respectively, $p = .01$).

Concerning the second analysis (translation condition), lme analyses were conducted based on the same factorial design, except for the Relatedness factor, as presented below. For the sake of simplicity, only the main effect of Relatedness and its interaction with other factors when statistically significant on latency and error data were reported. For each predictor in the model, a set of one or more reference levels were created with the lsmeans procedure (Lenth, 2016). A reference grid was hence the set of all combinations of reference levels for all factors. For the Relatedness factor, however, the Translation, Related and Unrelated levels were orthogonally coded (J-1 two levels) with the first contrast of Related and Unrelated taken together (−2,1,1) against Translations, and a second contrast, independent of the first one, that contrasted Related against Unrelated (0,1,−1). This family of two contrasts is orthogonal and hence completely independent. In this way, the predicted marginal means estimated ensure the total independence of both comparisons within the combination of the other levels of the other factors. As expected, the results revealed that participants were faster in the translation condition compared to incorrect translation pairs (related and unrelated conditions altogether), $F(1, 44.5) = 78.76$, $p < .001$, and they also made fewer errors $\chi 2(1) = 6.09$, $p = .01$. The two-fold interaction Cognate status x Relatedness was also significant on the latency, $F(1, 3439.3) = 61.40$, $p < .001$, and error data, $\chi 2\ (1) = 6.87$, $p = .008$. The interaction showed that translations were recognized quickly and more accurately than incorrect translations, particularly for cognate words (*p*s < .001 for cognates in the RT and error analysis, and $p = .053$ and $p = .30$ for non-cognates in the RT and error analysis, respectively). Moreover, the cognate facilitation effect was only significant for translations in RTs and errors (both *p*s < .001). Interestingly, the three-way interaction Relatedness x Test moment x List composition also reached statistical significance in the latency data $F(1, 3392.2) = 9.65$, $p = .001$. Overall, the analysis of the latency data showed faster responses to translations than to incorrect translation pairs in both immediate and delayed tests and regardless of list composition (all *p*s < .01, see Figure 3).

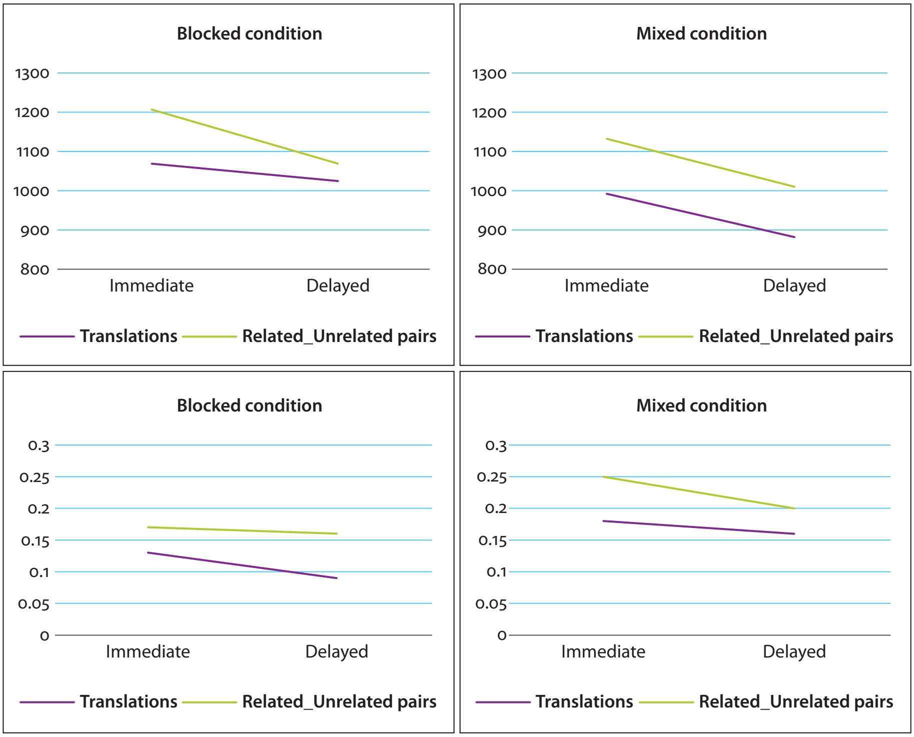


**Figure 3.** Graphic representation of the three-fold interaction (Relatedness, Test Moment and List composition) observed in the second analysis (when translations were considered) on the latency data (two graphs above) and on error rates (two graphs below)

The interaction also showed that participants from the Blocked list were equally fast for translations in the delayed test as in the immediate test ($p = .15$), whereas participants from the Mixed list were faster for translations in the delayed test than to translations in the immediate test ($p = .002$).

## 4. Discussion

The aim of this study was to explore, for the first time, the role of stimuli list composition in the establishment and stability of L2-word-to-concept interlanguage connections at early stages of L2 vocabulary acquisition in children. To that end, EP-Basque cognate and non-cognate words were learned in a blocked vs. mixed way, by using an L2 word-picture learning method. Immediately after learning and a week later, EP children performed a backward translation recognition task in order to test list composition effects and the stability of results. The findings showed that even though children that learned the L2 words in a blocked way made fewer errors than children that learned the same words in a mixed way, the SIE did not vary as a function of list composition. That is, children from both lists made more errors when rejecting semantically related words than semantically unrelated words. In reaction times, the SIE was restricted to cognate words. Overall, the findings replicated those of Comesaña et al. (2012a) in a study that used mixed lists, extending them to another learning design that used blocked lists. Besides, results were also consistent with the literature on L2 acquisition in children showing a facilitation effect of cognate words in learning (cognate words are learned faster and more accurately than non-cognate words), probably because cognates receive more semantic co-activation from similar lexical representations (see Comesaña et al., 2012b; Dijkstra et al., 2010; Timmer, Ganushchack, Ceusters, & Schiller, 2014) or because they have more distributed features at a semantic level (see de Groot, 1992; van Hell & de Groot, 1998).

The fact that we failed to corroborate our hypothesis regarding the effect of list composition in the establishment of L2 lexical-semantic connections led us to think about the role of word type in learning. According to the BIA models (BIA and BIA+), during L2 word recognition there is a non-selective activation of the lexical representations of words in both languages. This cross-language co-activation may be increased as a function of the type of words presented (see Comesaña et al., 2015 for more detail about the influence of word type on L2 word processing). Thus, it is likely that when cognate translation equivalents (words that, besides meaning, also share form) are presented to children, they realize that similarity can be a valid cue to the learning of the new words, no matter the way in which the words are presented. If this is so, lexical links would be reinforced, as

Comesaña et al. (2012a) have pointed out. That is, once participants see translation equivalents that are similar in form, they might adopt a lexically mediated strategy to learn the new words presented in the experimental list. This lexically mediated strategy in L2 word acquisition has already been advanced by Comesaña et al. (2012a) to explain the advantage observed for the L2-L1 words method over the L2-picture method. Following the same line of reasoning, we might argue that if children were asked to learn false friends (words that are similar in form, but not in meaning; e.g., fabric and fábrica, the Portuguese word for factory) together with cognate and non-cognates, they would probably adopt a more conceptually based strategy to learn the words, since in this scenario word form would not be a valid cue to L2 learning/recognition. In such a situation, a method that reinforces conceptual connections like the one used in the present research would, hence, be more effective. We acknowledge, however, that this hypothesis is somewhat speculative and more research is needed in order to prove its validity. For instance, future studies could assess the performance of children in a backward translation recognition task using false friends, cognate and non-cognates words. These children would be assigned to two different learning conditions; half would learn the three types of words, while the other half would only learn cognate and non-cognates, as in the present study. In both cases, the response to false friends would be negative since they are not translation equivalents. The results would allow us to disentangle the effect of form overlap in the establishment of L2 lexical-semantic connections, given that if form is driving the type of connections, the group who do not learn false friends would not only make more errors with translations than the other group, but would also show a reduced SIE. Moreover, research on these lines would contribute to our understanding of whether learning false friends increases metalinguistic awareness, a factor that has been highlighted as a key factor in L2 word acquisition (see Otwinowska, 2016).

Leaving aside the fact that list composition did not influence the cross-language lexical-semantic connections as captured by the SIE, it is important to note that, globally, the results obtained on error data seem to suggest that learning L2 cognate and non-cognate words in a blocked manner is more effective than learning them in a mixed manner. This idea is supported by two main findings: on one hand, children from the blocked condition made fewer errors than children from the mixed condition, especially with cognate words, and, on the other hand, their responses to correct translations were more stable over time, regardless of the cognate status of the words learned, as revealed by the three-fold interaction (see Figure 3). This advantage can be explained by differences in the response criteria used by children from both learning conditions (blocked vs. mixed). Since children from the blocked condition did the translation recognition task with either cognate or non-cognate words, they could have adapted their responses as a function of the type of words presented. That is, if words are similar in form (cognates) the response would be positive. Conversely, if words were non-cognates, the decision would be more difficult because the only valid cue would be meaning. This could explain why children from the blocked condition made significantly fewer errors with cognate words than children from the mixed condition. Indeed, children from the mixed condition learned cognate and non-cognate words together, and thus they might have learned implicitly that word form was not a reliable cue on which to base their responses.

Finally, we should stress that the findings of the present research not only have theoretical implications for the RHM, but also important ramifications for foreign language teaching strategies. Although any considerations about the pedagogical implications of this research are beyond the scope of this paper, it is possible to anticipate, for instance, that despite the fact that list composition did not affect the SIE, teaching cognate and non-cognate words in a blocked manner may ease learning process and increase metalinguistic awareness.

Regarding the theoretical implications for the RHM, our results, together with those seen in previous studies (Chen & Leung, 1989; Lotto & de Groot, 1998; Comesaña et al., 2009, 2012a, 2015), indicate that the nature of L2 lexical-semantic connections varies as a function of the learning method and the type of words to be learned. The effects of these two variables seem not to be independent of each other. Indeed, the advantage of a conceptual based method in the establishment of direct L2 lexical-semantic connections disappears when cognate words are presented in the experimental list (no matter whether blocked or mixed), at least when learners are children. This probably occurs because the presence of cognate words in the list reduces the ability of novice learners to inhibit the L1 (note that L1 inhibition is a key aspect of SLA; Linck, Kroll, & Sunderman, 2009). In fact, as claimed by Jiang (2000), a lack of dependency on the L1 while learning the L2 could largely improve the development of direct L2 lexical-semantic connections. Similarly, according to Grainger et al. (2010), a common lateral inhibitory network system, integrating lexical representations from both languages, develops as L2 proficiency increases (allowing for an initial RHM model to develop into a BIA one). The maturation of this system is due to an improved ability to inhibit L1 lexical representations when processing the L2 or vice-versa, that is, to the development of a more refined language-control mechanism, which may be influenced by L2 proficiency, as proposed by Grainger et al., and by variables like word type. Therefore, it would be interesting to examine the developmental trajectory of this mechanism in child and adult learners of a new language by manipulating the word type (e.g., cognates, non-cognate and false-friends). Data from such research would be key in understanding how L2 learners integrate new words into their mental lexicon and how lexical access occurs. It would also offer valuable new insights to L2 instructors on more efficient ways to teach L2 words.

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## Appendix A. Experimental prime-target pairs (English translations within brackets)

| | Basque word | Correct EP translation | Semantically related word (EP) | Semantically unrelated word (EP) |
|---|---|---|---|---|
| **Cognate pairs** | aktore | actor [actor] | teatro [theater] | sábado [Saturday] |
| | aireportu | aeroporto [airport] | aviões [planes] | normas [rules] |
| | arku | arco [bow] | redondo [round] | furioso [furious] |
| | armairu | armário [closet] | roupa [clothing] | ponta [nib] |
| | banku | banco [bank] | sentar [to sit] | limpar [to clean] |
| | kafe | café [coffee] | chávena [cup] | caverna [cave] |
| | kaxa | caixa [box] | guardar [to stow] | desejar [to wish] |
| | zinema | cinema [cinema] | filme [movie] | apoio [support] |
| | korrikaldi | corrida [race] | velocidade [speed] | integração [integration] |
| | eskola | escola [school] | aprender [to learn] | proteger [to protect] |
| | família | família [family] | pais [parents] | greve [strike] |
| | ospitale | hospital [hospital] | doentes [patients] | fortes [strong] |
| | irla | ilha [island] | deserta [desert] | cuidada [taken care of] |
| | lanpara | lâmpada [lamp] | luz [light] | rede [net] |
| | lapitz | lápis [pencil] | escrever [to write] | utilizar [to use] |
| | liburu | livro [book] | ler [to read] | cair [to fall] |
| | mediku | médico [doctor] | doutor [doctor] | outono [autumn] |
| | pareta | parede [wall] | branca [white] | activa [active] |
| | erradio | rádio [radio] | ouvir [to listen] | viver [to live] |
| | erloju | relógio [watch] | horas [hours] | acções [actions] |
| | arrosa | rosa [rose] | flor [flower] | libra [pound] |
| | zopa | sopa [soup] | legumes [vegetables] | bonecos [dolls] |
| | tapiz | tapete [rug] | chão [floor] | negro [black] |
| | testu | texto [text] | palavras [words] | semanas [weeks] |

| | Basque word | Correct EP translation | Semantically related word (EP) | Semantically unrelated word (EP) |
|---|---|---|---|---|
| **Non-cognate pairs** | zuhaitz | árvore [tree] | folhas [leaves] | faixas [bands] |
| | itsasontzi | barco [boat] | mar [sea] | povo [people] |
| | haragi | carne [meat] | comer [to eat] | dgever [to owe] |
| | beribil | carro [car] | automóveis [automobiles] | histórico [historical] |
| | bihotz | coração [heart] | amor [love] | fogo [fire] |
| | bizkar | costas [back] | coluna [spine] | quantia [amount] |
| | sukalde | cozinha [kitchen] | comida [food] | larga [long] |
| | eraikin | edifício [building] | prédio [building] | código [code] |
| | iturri | fonte [fountain] | água [water] | ideia [idea] |
| | eliza | igreja [church] | padre [priest] | álbum [album] |
| | leiho | janela [window] | vidro [glass] | envio [sending] |
| | egunkari | jornal [newspaper] | notícias [news] | unidades [units] |
| | esne | leite [milk] | vaca [cow] | tela [screen] |
| | mingain | língua [language] | portuguesa [portuguese] | responsável [responsable] |
| | esku | mão [hand] | dedos [fingers] | bares [bars] |
| | txanpon | moeda [coin] | dinheiro [money] | serviço [service] |
| | ohar | nota [mark] | teste [test] | rumo [course] |
| | harri | pedra [stone] | dura [tough] | vaga [vacancy] |
| | cárcel | prisão [prison] | ladrão [thief] | credor [creditor] |
| | mutil | rapaz [boy] | rapariga [girl] | guitarra [guitar] |
| | itzal | sombra [shadow] | escura [dark] | mágica [magic] |
| | adinekoak | velho [elderly] | idoso [elderly] | ácido [acid] |
| | haize | vento [wind] | frio [cold] | culto [educated] |
| | ardo | vinho [wine] | uva [grape] | cruz [cross] |

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